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ROM FOR ELASTODYNAMICS INCLUDING VISCOELASTIC BEHAVIORS. FROM MATERIAL IDENTIFICATION TO PART DESIGN.

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The talk will deal with numerical simulations of parts or structures computed with linear elastodynamic equations. The vibroacoustic-simulations aims are to compute complex or real eigenmodes and eigenvalues, to plot Frequency Response Functions, to compute transient or frequency responses under random excitation or shock excitation, see Rouleau et al. [6]. In such framework, computing large scale models is time-expensive because time-integration, eigenvalue extraction and frequency dependent stiffness-matrix inversion require numerous matrix-inversions which are expensive when the model contains a large number of degrees of freedom. Moreover, taking into account viscoelastic behaviors makes the stiffness-matrix, complex and frequency-dependent. To obtain a formulation available either in time-domain and in frequency-domain, It is necessary to use a special formulation with internal state-variables. Neithertheless, with this kind of formulation, the number of Degrees of freedom increases. To keep fairly short simulations, it is necessary to use suitable formulations and methods for model reduction. Lesieutre et al. [4] proposed Anelastic Displacement Fields as added-state-variables to formulate such kind of problem. Our work proposes a formulation very close the Lesieutre's one, which avoid badly-conditioned matrices. In such formulation, the number of internal states can be very large when the frequency range of interest in large and when there are several different viscoelastic materials in the structures, see Chevallier et al. [3]. Our work proposes a method for identifying the materials using the same time-constants in order to avoid the increasing of the internal state-variables, see Renaud et al. [1] and [2]. To reduce the initial number of DOF, the talk will propose and compare Ritz-methods based on the use of subspaces spanned by modal vectors, modal vectors and static corrections, see Plouin et al. [5], iteratively built modal basis and a low-frequency basis enhanced with a high frequency basis. These methods are compared in terms of "off-line" computations, "on-line" computations and of course, accuracy. Figure 1 show the benchmark that we used to test the numerical methods. It is a sandwich beam constituted with three viscoelastic materials and a purely elastic one.

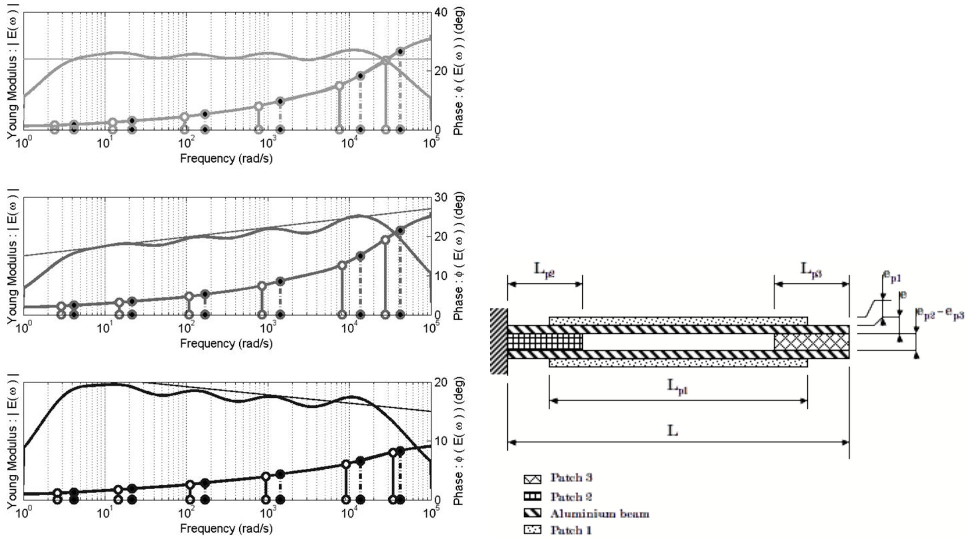

Figure 1: Numerical benchmark. Sandwich Beam.
Left: Storage Modulus and Loss Factor of the three materials
Right: Schema of the Benchmark.

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